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REPORT NO. TASK III - 7 MONTHLY PROGRESS REPORT

ENGINEERING PROGRAM FOR
THE PILOT PRODUCTION OF A
LIGHTWEIGHT ANTITANK WEAPON

#6

FOR THE PERIOD

MONTH OF NOVEMBER 1960

CONTRACT NO. RD-142

ORDNANCE PROJECT NO.

DEPT. OF ARMY PROJECT NO.

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FLIGHTEX FABRICS, INC.

PROGRESS REPORT #7

ENGINEERING PROGRAM FOR THE PILOT PRODUCTION OF

A LIGHTWEIGHT ANTITANK ROCKET

NOVEMBER 1960

CONTRACT NO. RD-142

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WORK ACCOMPLISHED DURING THE MONTH OF NOVEMBER 1960

SYSTEM EVALUATION PROGRAM

All points mentioned in the section "Future Program" in last months progress report have been fulfilled, or are being worked on. The problem posed by the failure of the system to be drop safe when the Test Schedule A (Spec T 310) was conducted in October has been solved in a way which will make it possible to deliver drop-safe systems to the Contracting Authority without radical redesign and without any substantial increase in cost to the present contract.

The first batch of HEAT systems was packed and picked up during the month. According to instructions received from the project officer, the modifications required to make the system drop-safe on a 40ft. drop were not incorporated in the systems shipped as the first batch of 200. These changes will, however, be incorporated in future batches.

The batch of practice systems (250) was completed, the accuracy test at 50 and 100m was conducted and the check out test of practice systems was run off. No problems showed up during this procedure and the practice systems are currently being canned and packaged ready for shipment.

Batch 2 HEAT was also finished during the month and the check out test was conducted. This batch was found to be acceptable with the armor penetration achieved during the check-out test at 6.9" average. The fact that this

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pilot production lot is used, in part, to establish what the penetration of the system will be when manufactured under production conditions, must be borne in mind. The present Specification does not call for any particular amount of penetration. At the outset of the contract, a minimum of 6" was cited as the target figure. This will be exceeded, based on past performance, however it is doubtful whether an average penetration of 9" or better could in all fairness to the weapon be expected, at least without considerable R & D work on the head.

Canning of the HEAT batch No. 2 is also in progress and batch 3 will be assembled and checked out before the end of December.

DROP SAFETY

The sleeve which was designed to eliminate this problem was tried out in a drop test on November 3rd. Two packaged and two unpackaged systems were dropped 40 feet on a steel base. (Test A-5). This test actually calls only for a drop with the system in the can, however, it was felt that the effect of the sleeve behind the truarc washer on the ignitor would materially improve drop safety even without the can.

The result of this test were that one packaged and one unpackaged round initiated their respective primers and one of both types was safe.

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Examination showed an altogether different condition than the one observed on the previous occasion. It was found that the crosspiece had remained in position, as expected, but that due to set-forward forces acting on the trigger linkage, the linkage had moved forward and that, in so doing, it had deformed the actuating lever and made the safety pin shear through the polyethylene of the crosspiece. The result was compression of the firing spring. In the case of the rounds which were not initiated, the motion imparted to the firing pin was insufficient to release it, but in the case of the rounds which were initiated, the firing pin had been moved back far enough to be released by the actuating lever, resulting in initiation of the primer. All rounds were fired without propellant charge, but with a black powder charge in the igniter. In this way it was possible to observe the results safely.

The decision was then made to place a support into the package which would prevent the forward motion of the trigger linkage. This was accomplished by means of a piece of aluminum tubing tapped on one end and fitted with a jackscrew, which is used to take up tolerance build-up. This support makes contact with the plastic front support on one side, and fits over the end of the trigger linkage on the other. It is being centered by the ends of the front sight band and held in place by the fact that the jack-screw is pointed and thus sticks into the plastic front support.

Four systems were assembled and canned to check out this new approach. The result was that all four systems were not only drop-safe but fully

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operable after 40 ft. drop. The necessary drawings were prepared and components are being manufactured for incorporation into all future systems.

HEAT HEAD EVALUATION PROGRAM

The loading of heads has been speeded up to a rate of 40 heads per day. This is still considerably less than was anticipated, but it should make it possible to continue assembly and acceptance testing without major delays.

Mr. Cox from the Universal Match Company visited the J2 range on November 25 and observed the pouring of the heads. He made several suggestions which may be useful in producing a better end product. He pointed out that the heads for the R & D lot were poured at as low a temperature as possible in order to cut down on contraction after pouring. He also told us that they used a steam-jacketed pouring funnel and did a considerable amount of stirring of the charge with heated probes. He suggested trying funnels with much larger holes for pouring and the omission of the booster detail in the funnel. This will be tried as soon as it is possible to obtain modified funnels.

From a point of view of assembly the head is the only item which has taken more time than anticipated, most other assemblies having presented little or no problem in assembling. From a point of view of performance, the average of 6.9" obtained in the acceptance test conducted on November 29 is somewhat

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dissappointing. The remark made in the System Evaluation section of this report applies to this problem, however, the following points will be noted in order to have a record of anything which may contribute to changed performance of the head. It is also well to realize the fact that we may not be confronted with any appreciable change in performance. In order to define the situation as well as possible, we have to compare the acceptance tests and the R & D dynamic evaluation tests and we find two broad categories of factors which may affect the results of such tests:

A. Factors affecting test conditions.

Such factors would produce different results with the identical item. As far as is presently known they are:

1. Different type of armor plate

The plate used in both cases is scrap armor, which, of course, does not define the material very fully. The plate used for R & D evaluation was considerably rougher in appearance than the plate supplied for the present series of acceptance tests.

2. Differences in test set-up

These consist merely in the fact that some of the rounds fired during acceptance testing have been conditioned to hot and cold temperatures and some rounds were subjected to humidity cycles prior to testing. The tabulation of test results shows no indication of any effect of temperature. Rd 7 and Rd. 9 both show low penetration 9 was hot and 7 cold.

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B. Factors affecting the item

Such factors would produce different results under identical test conditions due to changes in the item. The following is a list of such factors:

1. Change in the method of pouring the head.

This has been pointed out in previous reports. X-ray evaluation and the small number of static tests which were conducted do not of necessity shed too much light on this possible source of changes in performance. In evaluating the X-rays the findings of Picatinny Arsenal, based on tests with the M31 Rifle Grenade heads (loaded with Comp. B) were used to the effect that cavities of up to a maximum of 3/8" crosssectional area do not produce any effect on the penetration of the head. The question whether this is applicable to this present head or not is left open.

2. Changes in the physical properties of the head metal parts.

In this category belong such facts as the following:

a) Out of roundness of the head body.

During the current run we found out that the OD of the head body had to be centerless ground in order to pass through the Go ring gage. In spite of the fact that the same tools had been used, this problem did not arise during the run in 1959 (R&D). The body had been chucked in a different manner when machining the threads. In examining the remaining R & D heads this out of round condition does not seem to exist. Such a condition may very well affect the action of the initiated explosive charge on the copper liner.

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b) Change in the type of steel used for the head. We know that Eastern Tool Company had some initial trouble in obtaining the deep drawn forms when they first started work on the heads. They had to change material and chromeplate the tools before the deep drawing was successful. Changes in ogive metal may affect the amount or consistency of crush-up of the ogive when hitting the target.

3. Change in explosive properties

a) The booster has been changed from Tetryl to RDX. Again based on tests conducted at Picatinny Arsenal with the MBI head such a change should produce no effect on the action of the head as far as armor penetration is concerned. Not enough static tests can be run within the scope of this contract to determine whether the same holds true for this head.

b) Action of the detonator. It was observed that two detonators used in dynamic tests and two used in static tests for evaluating the difference in action of RDX versus Tetryl failed to initiate the booster.

In addition a combination of factors under A and B would further obscure clearcut evaluation of head performance.

The reason so much space is given to the evaluation of penetration is the fact that it is extremely easy to start research programs, when the results of penetration tests appear disappointing or, on the other hand, to over-estimate the effect of the weapon, when results appear better than expected.

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FUZE EVALUATION PROGRAM

With the exception of the fuze on Round 3, all fuzes operated properly. Round 3 was a dud, however, this was caused by a low order detonator. Examination of the fuze was possible since burnmarks were visible through the slots for the safety pins, indicating that the detonator had operated. After letting the round lay for several hours it was disassembled. The rotor had armed and the firing pin was in a forward position, the detonator had been initiated but the amount of damage done to the fuze components was much less than is customary when firing a fuze in a practice head with a detonator. The steel washer between the charge and the fuze had been pierced, but the hole was only 1/4" in diameter which is less than half of what can be expected under normal conditions. Part of the detonator was still embedded in the booster and our explosives expert feels that the tetryl RDX charge in the detonator had consolidated too much to be initiated.

This problem has been pointed out previously (May report, September report) and after consulting with the project officer, it was decided not to take any action thereon at the present time but to continue recording failures of this nature in order to compile a better statistical background.

Fuze assembly is proceeding well, with all components in the house at the time of writing this report.

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MOTOR EVALUATION PROGRAM

The biggest remaining problem under this heading is the delivery of some 700 motors still owed to Hesse-Eastern by Harvey Aluminum Company. A delivery promise of 100 motors by November 25 was not lived up to. The Company was visited by a representative from Hesse-Eastern. Motors in process were observed and it was felt at the time (November 23-25) that we should be able to expect delivery very shortly. The experience with Harvey Aluminum most certainly points out the great importance of not using extruded components for an item of this nature. It seems not to offer many advantages, especially when considering the fact that the design does not need to be optimal from the point of view of weight, as would be the case with some official Ordnance item.

The new steel motor barriers are one half finished. Some delays caused by a leak in the hydrostatic test fixture have been encountered. This is being corrected and should cause no delay to the overall program.

All motors tested during the month (88 total) have performed safely and within the velocity as experienced in the R & D Program.

A 50 round accuracy test at 50 and 100m was conducted at the request of the Contracting Authority in addition to the Test Schedule B prior to canning and delivering the practice systems.

From the point of view of motor evaluation this test is of importance because it has increased the statistical sample now available of motors fired since August without failure in respect to the motor barrier blowing out.

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LAUNCHER EVALUATION PROGRAM

The launchers have been easy to assemble and package. No problem in this area appears to exist at the present time. 1,000 launchers had been assembled ready for loading before the present loading operation started. Due to lack of outer tubes assembly of the remaining 700 launchers had to be postponed until a later date. The tubes have now been received and machined. The remaining launchers will be assembled by mid-January ready for loading.

All launchers operated properly when tested and the sights appear to correspond with the trajectory of the round as they should.

ACCEPTANCE TESTS

The following is a tabulation of the acceptance test conducted on November 25 and 29.

BATCH II HEAT

Quality Control Test

<u>Rd. No.</u>	<u>Test</u> (Per T-310)	<u>Aim</u>	<u>Hit</u>	<u>11-29-60</u> <u>Penetration</u> (inches armor)	<u>Comments</u>
1	B ₃ Water	9-15	9-11	6 1/2	
2	B ₃ Water	12-15	10-12	7 1/2	
3	B ₃ Water	9-21	6-16	Dud	Low Order Detonator
4	B ₃ Water	15-21	18-17	10 1/2	
5	B ₂ Cold	6-21	12-21	3 1/2	
6	B ₂ Cold	6-21	15-23	11	

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<u>Rd. No.</u>	<u>Test</u> (<u>Per T-310</u>)	<u>Aim</u>	<u>Hit</u>	<u>Penetration</u> (<u>Inches armor</u>)	<u>Comments</u>
7	B ₂ Cold	6-21	5-18	2	
8	B ₂ Cold	6-27	12-28	8	
9	B ₁ Hot	6-21	4-19	2	
10	B ₁ Hot	9-21	7-16	6 1/4	
11	B ₁ Hot	12-21	9-19	11	
12	B ₁ Hot	12-21	11-16	3 1/2	Pronounced Double Jet
13	B ₄ Humidity	12-21	13-18	8	
14	B ₄ Humidity	15-21	14-17	10	
15	B ₄ Humidity	18-21	15-17	8 1/2	
16	B ₄ Humidity	18-21	17-18	6 1/2	
17	B ₅ Graze				Functioned
18	B ₅ Graze				Functioned

The average penetration not counting Rd. 3 is 6.9" and it must be stated that Rds. No. 7 and 9 show unusually low penetration. The factors which might contribute to this state of affairs have been discussed in the HEAT head section of this report. The results were discussed with the project officer and the decision was made to can the batch for shipment.

A second acceptance test was conducted together with the above in order to check out the practice systems. The following is a tabulation of the results. The target in this case was marked off in 1ft. squares. Aim and Hit points are given with the horizontal coordinate first.

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PRACTICE HEAD BATCH

Quality Control Test Range 50m

11-25 & 29-60

<u>Rd. No.</u>	<u>Test</u>	<u>Aim</u>	<u>Hit</u>
1	B ₆ Accuracy 50m	6-6	6-7
2	B ₆ Accuracy 50m	6-6	5 1/2-6
3	B ₆ Accuracy 50m	6-6	5 1/2-5 1/2
4	B ₆ Accuracy 50m	6-6	5 1/2-6
5	B ₃ Water	6-6	6 1/2-5 1/2
6	B ₃ Water	6-6	6 1/2-7
7	B ₃ Water	6-6	6-6
8	B ₃ Water	6-6	5-6
9	B ₂ Cold	6-6	6 1/2-7 1/2
10	B ₂ Cold	6-6	6-6
11	B ₂ Cold	6-6	6 1/2-6
12	B ₂ Cold	6-6	7-7
13	B ₁ Hot	6-6	6-5
14	B ₁ Hot	6-6	6 1/2-6
15	B ₁ Hot	6-6	6 1/2-6
16	B ₁ Hot	6-6	6 1/2-6
17	B ₄ Humidity	6-6	6 1/2-6
18	B ₄ Humidity	6-6	6 1/2-6
19	B ₄ Humidity	6-6	7-6
20	Ambient	6-6	7-6

As can be seen all rounds hit well within the 3 1/2 foot square established during the R & D program.

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Upon the request of the contracting authority a fifty round test for accuracy at 50 and 100 meters (25 rds. each) was conducted. The results as well as photographs of both targets are shown in the appendix to this report. A small amount of side wind was experienced during the 100m test which accounts for the fact that the group is generally located to the left. The accuracy of the system again checks out well, but it must be pointed out that better interior ballistics would materially improve the results.

STATIC TRAIN FUNCTION TESTS

These tests were completed during the month and a tabulation of the results follows:

Tabulation of Train Functioning

Tests November 1960

<u>Shot No.</u>	<u>Type</u>	<u>Plate Bent to Included Angle of (Degrees)</u>	<u>Hole Diameter (approx.)</u>
19	RDX	Split	5/8
20	RDX	70	1 1/8
21	RDX	130	5/8
22	RDX	90	11/16
23	RDX	110	3/4
24	RDX	70	1 1/4
25	RDX	0	9/16
26	RDX	120	9/16
27	RDX	90	1/2

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<u>Shot No.</u>	<u>Type</u>	<u>Plate Bent to Included Angle of (Degrees)</u>	<u>Hole Diameter (approx.)</u>
28	RDX	70	1
29	RDX	45	1
30	RDX	90	7/8
31	RDX	100	5/8
32	RDX	75	13/16
33	RDX	95	3/4
34	RDX	90	1
35	Tetryl	70	1/2
36	Tetryl	60	3/8
37	Tetryl	45	9/16
38	Tetryl	110	3/4
39	Tetryl	90	1
40	Tetryl	80	1 1/4
41	Tetryl	70	5/8
42	Tetryl	100	7/16
43	Tetryl	90	11/16
44	Tetryl	85	3/4
45	Tetryl	75	1
46	Tetryl	110	7/8
47	Tetryl	90	1/2
48	Tetryl	90	1/2
49	Tetryl	110	7/16
50	Tetryl	100	3/8
51	RDX	100	1 1/8
52	RDX	120	1 1/4

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<u>Shot No.</u>	<u>Type</u>	<u>Plate Bent to Included Angle of (Degrees)</u>	<u>Hole Diameter (approx.)</u>
53	RDX	90	7/8
54	RDX	80	9/16
55	RDX	95	11/16
56	RDX	75	1
57	RDX	85	1 1/4
58	RDX	130	1 3/8
59	RDX	120	5/8
60	RDX	90	7/16
61	RDX	80	1 1/8
62	RDX	75	1 1/8
63	RDX	125	7/8
64	RDX	60	13/16
65	RDX	30	3/4
66	RDX	Split	9/16
67	RDX	100	7/8
68	RDX	90	1 1/8
69	RDX	90	1/14
70	RDX	85	1
71	RDX	75	1
72	RDX	85	3/4
73	RDX	100	7/8
74	RDX	90	13/16
75	RDX	120	11/16
76	Tetryl	Split	1/2
77	Tetryl	120	11/16

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<u>Shot No.</u>	<u>Type</u>	<u>Plate Bent to Included Angle of (Degrees)</u>	<u>Hole Diameter (Approx.)</u>
78	Tetryl	110	3/4
79	Tetryl	90	3/4
80	Tetryl	85	9/16
81	Tetryl	75	11/16
82	Tetryl	110	1 1/8
83	Tetryl	120	1
84	Tetryl	120	1 1/4
85	Tetryl	100	7/8
86	Tetryl	60	1/2
87	Tetryl	40	7/8
88	Tetryl	Split	?
89	Tetryl	Dud	---
90	Tetryl	110	1 1/8
91	Tetryl	90	7/8
92	Tetryl	85	1
93	Tetryl	75	1 1/4
94	Tetryl	100	1 1/8
95	Tetryl	Split	1
96	Tetryl	Split	3/4
97	Tetryl	95	9/16
98	Tetryl	85	7/16
99	Tetryl	75	1
100	Tetryl	Split	1 1/8

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As can be observed Rd. No. 89 is a dud caused by low order detonator. Rd. 9 (September Report) also was such a dud. No. 9 was testing an RDX booster whereas Rd. 89 tested a Teteryl booster. Similarly the round which did not fire when testing Dynamically (No. 3) was using the now standard RDX, whereas the round with a similar malfunction in May was making use of a Teteryl booster. It is therefore unlikely that the change in the type of booster can be blamed for this. The potential seriousness of this condition has been stressed already in previous reports, however, due to shortage of funds and time the decision was made to continue the program and to note the number of incidents of such malfunctions in tests before any further work is done on the subject.

3. Errata

Page 8 of the October Report should have point 3) re-written in the following way:

Knowing that 1ft at 50 feet corresponds to 3 1/4 feet at 50m the hit must then be recorded within 6" in any one direction of each coordinate. This allows for a 3 1/4 ft. square at 50m which is slightly smaller than called for on spec T 310.

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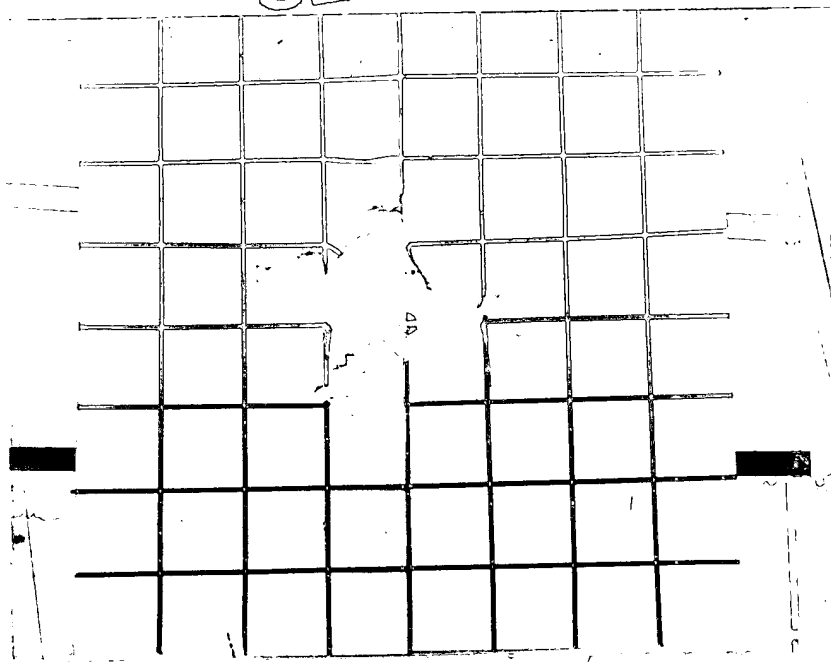
APPENDIX

1.) TABULATION OF 50 ROUND ACCURACY TEST

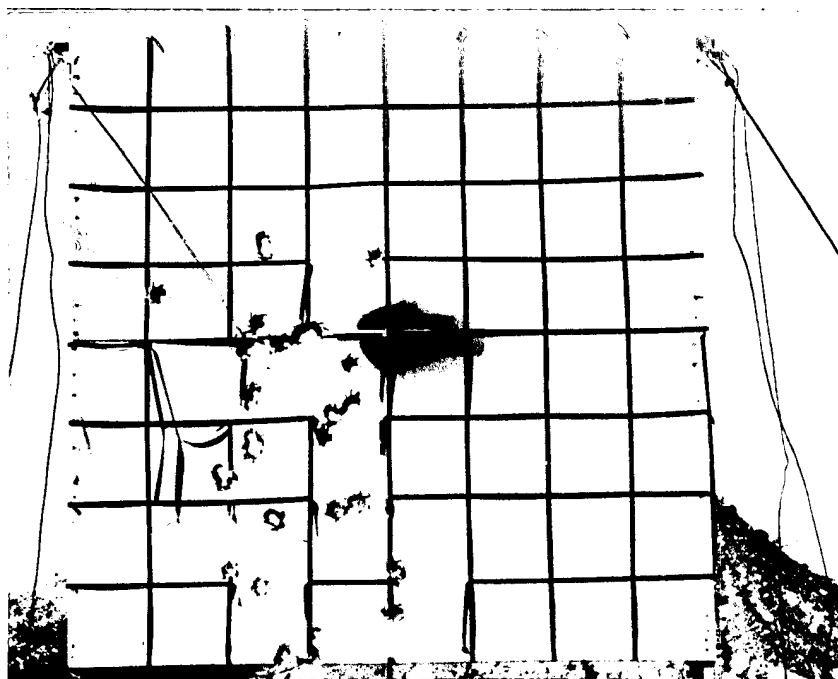
2.) PHOTOGRAPHS OF TARGETS

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Photograph of 50m Target
(25 rounds fired November 23)



Photograph of 100m target
(25 rounds fired November 23 & 24)

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